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Remarks:
The references to figure 4 are deemed to be deleted (Rule 43 EPC).

(54) Control of multi stage electrically driven compressor

(57) The invention relates to an innovative design of the multi-stage driven type compressor pump driving system for air condition and refrigeration applications, wherein it is by a particularly multi-stage driven type system structure to replace the varied frequency stage-less driving structure to obviously lower the cost to promote Electromagnetic compatibility(EMC), whereby to obtain the similar functions as of the varied frequency driving system.

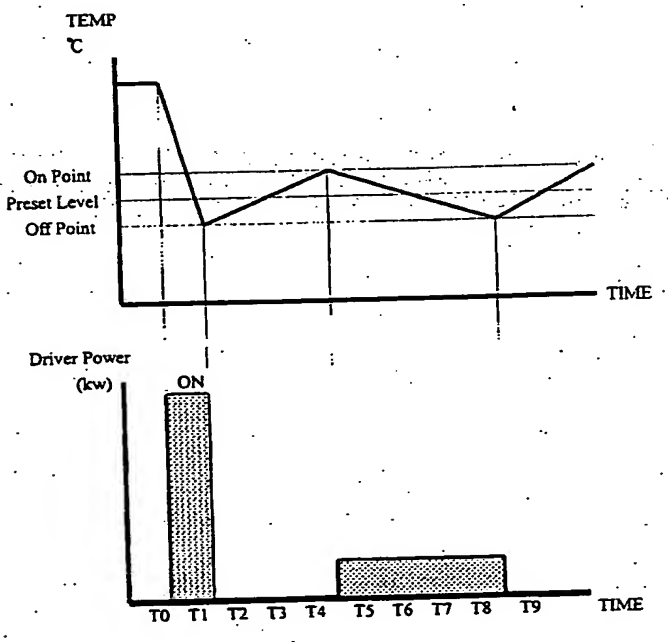

FIG. 5

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Description

BACKGROUND OF THE INVENTION:

(a) Field of Invention

[0001] The invention relates to an innovative design of the multi-stage driven type compressor pump driving system for air condition and refrigeration applications, wherein it is by a particularly multi-stage driven type system structure to replace the varied frequency stage-less driving structure to obviously lower the cost to promote Electromagnetic compatibility(EMC), whereby to obtain the similar functions as of the varied frequency driving system.

(b) Description of the Prior Art:

[0002] In recent years, the varied frequency type motor are popularly utilized in the home appliances such as refrigerators, air conditioners to obtain the following effects:

1. Refrigerator: The motor is controlled by the varied frequency power source for varied speed operations to further drive the compressor for varied speed operations; whereby it is through the high speed operation to shorten the temperature reducing time, and through the low speed operation to maintain the constant temperature status and to reduce noise thereby to save the power consumption.
2. Air condition: The motor is controlled by the varied frequency power source for varied speed operations, wherein through driving the motor at a higher frequency to further drive the compressor for high speed operations, the temperature reducing time is shortened; and through driving the motor at a lower frequency, the temperature has less pulsation changes to lower the noise and to save the power consumption.

[0003] Even though the above said functional effects are all positive, the high cost of the varied frequency type driven motor and its control devices as well as the electromagnetic compatibility (EMC) of the varied frequency driving controller have made the circuit more complicated, especially that the high price discourages purchases which makes the positive effects of all the power saving, convenience and low noise not able to be popularized.

SUMMARY OF THE INVENTION:

[0004] The main purpose of the invention is to provide a multi-stage driven type compressor pump driving system for air condition and refrigeration applications thereby to lower the cost and improve the electromagnetic compatibility(EMC) to obtain the similar functions as in the varied frequency type driving system.

BRIEF DESCRIPTION OF THE DRAWINGS:

[0005] Fig. 1 shows the compressor pump driving operation versus target temperature relationship of the conventional power driven air condition or refrigeration devices.

[0006] Fig. 2 is a constant temperature operating mode diagram of a newer varied frequency type driven system in the market.

[0007] Fig. 3 is the constituting block diagram of the multi-stage driven type compressor pump driving system for air condition and refrigeration applications.

[0008] Fig. 4 is a low speed support operating mode diagram of the multi-stage driven type compressor pump driving system for air condition and refrigeration applications.

[0009] Fig. 5 is a low speed constant temperature operating mode diagram of the multi-stage driven type compressor pump driving system for air condition and refrigeration applications.

DETAILED DESCRIPTION OF THE PREFERENCE EMBODIMENTS

[0010] The driving operation versus target temperature relationship of the conventional power driven air condition or refrigeration devices is shown in Fig. 1, wherein since only a single speed compressor pump is used for the intermittent operating mode of instant cooling operation or stop to constitute the temperature adjusting function, therefore for a preset temperature operation, the single motor in the intermittent operation tends to consume more power with high compressor noise as well as the big temperature variations which causes bad comfort; thereof for the existing newer model varied frequency driving system on the market use lower rotating speed for varied speed operation which is advantageous at stable temperature, low compressor noise and saving motor power, wherein its operating mode is as shown in Fig. 2, but the varied frequency type driving method are not quickly popularized due to its complicated system, high price and electromagnetic compatibility (EMC) problems; thereof the multi-stage driving type compressor pump driving system is designed to find the trade-off between the market acceptable price level and the good performance requirement, wherein it has multi-stage operating functions and a related particular structure capable of being controlled for the high power rate high rotating speed operation or the low power rate low rotating speed operation, while at preset temperature operation, it has the following three selectable preset temperature operating modes:

A. Low speed support operating mode: If the BTU value of the low power rate low rotating speed driven compressor pump is smaller than the required make-up BTU value for target temperature, then the system is first operated at high power rate high ro-

tating speed, and after the temperature is lowered to reach to the preset detecting temperature, the motor is controlled for low rotating speed low power rate operation for supportive temperature adjusting driving mechanism operation, wherein due to the low power rate low rotating speed operation is used at maintaining the constant temperature, the high speed high power rate operation densities are reduced to effectively elongate the temperature variation as well as to save the power consumption and to lower down the noise.

B. Low preset temperature operating mode: If the BTU value of the low power rate low rotating speed driven compressor pump is smaller than the required make-up BTU value for target temperature , then after the preset temperature is reached, through the low power rate low rotating speed operating function to do periodic adjusted temperature change along the temperature average line to save power and to reduce the noise.

C. Conventional single stage high rotating speed driving system operating mode: The constituting block diagram of the multi-stage driven type compressor pump driving system for air conditioning and refrigeration applications is as shown in Fig. 3, wherein the system constitution includes the following:

- A power source PS100: It includes the single phase or multi-phase AC power source or DC power source for supplying power to the primer driving motor, motor driving control circuit, fan driving motor and related control circuit, central controller, input circuit, display circuit and other peripheral devices of the compressor pump driving device;
- A compressor pump CP100: It is driven by the compressor pump driving device to do compression function on the coolant.
- A compressor pump driving device PD100 which includes:

  1) It can be driven directly by an AC motor for two stages or more than two stages rated speed operation without changing the power source voltage and frequency through switching the number of winding poles or switching the winding wiring to change the impedance, or through switching the series combined impedance of a single phase or multi-phase motor or switching the Y-Δ connection of the three-phase motor; or it can be driven through a speed reducer mechanism with a fixed speed ratio;
  2) It can be driven directly by a DC motor for two stages or more than two stages rated speed operation through switching the winding wiring to change the field strength or to change the impedance of the field or the armature, or it can be driven through a speed reducer mechanism with fixed speed ratio; or
  3) The compressor pump is driven by an AC or DC motor output shaft combined with a staged or stage-less varied speed mechanism, and is installed with a directly or indirectly power controlled clutch to switch the speed ratio of the staged or stage-less varied speed mechanism to relatively change the operating speed of the compressor pump.
  4) It is constituted by two or more than two AC or DC motor with different rated rotating speed and different power, wherein they are alternatively operated in different rotating speed and different power rates;

- A driving control device CD100: It is constituted by electromechanical devices or solid state electronic components, wherein it is controlled by the central controller to relatively control the output rotating speed of the compressor pump driving device;
- A central controller CCU100: It is an analog or digital control circuit which is constituted by electromechanical devices or solid state electronic components, wherein it receives the wired or wireless systematic control signal or preset signal from the manual operating input device or remote manual control device as well as the detected signal from the temperature or humidity detector devices, etc. to relatively through the control driving device CD100 to further control the compressor pump driving device;
- An input operating device IP100: It is constituted by electromechanical devices or solid state electronic components which includes:

  1) A manual input operating device MI100;
  2) A Wired or wireless remote control input operating device RI100;
  3) A Wired or wireless system input operating device SI100;
  4) The internal preset automatic control device II100;

  The input operating device can be selectively constituted by one or more than one of the aforesaid 1) – 4) input operating devices for temperature preset or other functions operations;
- An environment detector device TS100: It is the temperature detector device constituted by electromechanical or solid state electronic

components for detecting the target temperature and transmitting the signal to the central controller unit CCU100 to do corresponding control. The system operating mode as shown in Fig.3 is as following:

1) Low speed support operating mode: When the target surrounding temperature is higher than the ON point of the preset level (i.e if the temperature is higher than this value, the compressor pump will be driven), the compressor pump is driven by the compressor pump driving device at the high power rate high speed OFF point of the preset level (i.e. the conventional single speed compressor pump is stopped if this temperature value or lower value is reached), the compressor pump is switched to low power rate low speed operation, and if the target temperature is further lowered, the pump is stopped; thereof if the target temperature is slowly risen to the ON point of the preset level when the pump is driven at the low power rate low speed operating status, the compressor pump is switched to high power rate high speed operation to lower the target surrounding temperature to the OFF point of the preset level and is further switched to low power rate low speed to drive the compressor pump, and the cyclic operations are continued as said, wherein this mode is applicable for medium target temperature loss operation requirements; wherein Fig 4 is a schematic diagram of the invention at low speed support operating mode operation.

2) Low speed constant temperature operating mode: When the target surrounding temperature is higher than the ON point of the preset level (i.e if the temperature is higher than this value, the compressor pump will be driven), the compressor pump is driven by the compressor pump driving device at the high power rate high speed OFF point of the preset level(i.e. the conventional single speed compressor pump is stopped if this temperature value or lower value is reached), the compressor pump is switched to low power rate low speed operation, and if the target temperature is further lowered, the pump is stopped; thereof if the target temperature is slowly risen to the ON point of the preset level when the pump is at the stopping status, then the compressor pump is switched to low power rate low speed operation to lower the target surrounding temperature to the OFF point of the preset level and is further switched to low power rate low speed to drive the compressor pump, and the cyclic operations are continued as said, wherein this mode is applicable for slower target temperature loss operation requirements; wherein Fig 5 is a schematic diagram of the invention at low speed constant temperature operation.

3) For the larger target surrounding temperature loss, it is operated according to the conventional single stage high rotating speed driving system mode.

When the multi-stage driven type compressor pump driving system for air conditioning and refrigeration applications is applied for the refrigerators or air conditioners, the power saving, low noise driving mode of the compressor pump is as aforesaid; thereof for application in air conditioners, the following interface devices are further installed:

- An interface driving circuit ID100: It is constituted by electromechanical devices or solid state electronic components to receive the operating signals of the central controller unit CCU100 to control the operating time of the air conditioners and to control the fan F100 for startup or stop or varied speed operations and wind direction controls as well as to drive the display device DP100 or other interface devices.

[0011] As summarized from the above descriptions, the multi-stage driven type compressor pump driving system for air conditioning and refrigeration applications of the invention discloses a particular compressor pump driving device capable of multi-stage driving operations to drive the compressor pump for multi-stage rotating speed operations and particular interactive operations according to the preset target temperature, thereby to obtain the progressiveness of low noise and power saving, wherein its cost is greatly reduced than the varied frequency systems with a better electromagnetic compatibility (EMC) to increase its practical usefulness with definite functions.

Claims

1. A multi-stage driven type compressor pump driving system for air conditioning and refrigeration applications, wherein it has multi-stage operating functions and a related particular structure capable of being controlled for the high power rate high rotating speed operation or the low power rate low rotating speed operation, whereof its system constitution includes the following:

- A power source PS100: It includes the single phase or multi-phase AC power source or DC power source for supplying power to the primer driving motor, motor driving control circuit, fan driving motor and related control circuit, central controller, input circuit, display circuit and other peripheral devices of the compressor pump driving device;
- A compressor pump CP100: It is driven by the compressor pump driving device to do compression function on the coolant.
- A compressor pump driving device PD100 which includes:

  1) It can be driven directly by an AC motor for two stages or more than two stages rated speed operation without changing the power source voltage and frequency through switching the number of winding poles or switching the winding wiring to change the impedance, or through switching the series combined impedance of a single phase or multi-phase motor or switching the Y-Δ connection of the three-phase motor; or it can be driven through a speed reducer mechanism with a fixed speed ratio;
  2) It can be driven directly by a DC motor for two stages or more than two stages rated speed operation through switching the winding wiring to change the field strength or to change the impedance of the field or the armature, or it can be driven through a speed reducer mechanism with fixed speed ratio; or
  3) The compressor pump is driven by an AC or DC motor output shaft combined with a staged or stage-less varied speed mechanism, and is installed with a directly or indirectly power controlled clutch to switch the speed ratio of the staged or stage-less varied speed mechanism to relatively change the operating speed of the compressor pump.
  4) It is constituted by two or more than two AC or DC motor with different rated rotating speed and different power, wherein they are alternatively operated in different rotating speed and different power rates;

- A driving control device CD100: It is constituted by electromechanical devices or solid state electronic components, wherein it is controlled by the central controller to relatively control the output rotating speed of the compressor pump driving device;
- A central controller CCU100: It is an analog or digital control circuit which is constituted by electromechanical devices or solid state electronic components, wherein it receives the wired or wireless systematic control signal or preset signal from the manual operating input device or remote manual control device as well as the detected signal from the temperature or humidity detector devices, etc. to relatively through the control driving device CD100 to further control the compressor pump driving device;
- An input operating device IP100: It is constituted by electromechanical devices or solid state electronic components which includes:

  1) A manual input operating device MI100;
  2) A Wired or wireless remote control input operating device RI100;
  3) A Wired or wireless system input operating device SI100;
  4) The internal preset automatic control device II100;

  The input operating device can be selectively constituted by one or more than one of the aforesaid 1) ~ 4) input operating devices for temperature preset or other functions operations;

- An environment detector device TS100: It is the temperature detector device constituted by electromechanical or solid state electronic components for detecting the target temperature and transmitting the signal to the central controller unit CCU100 to do corresponding control.

2. The multi-stage driven type compressor pump driving system for air conditioning and refrigeration applications as in claim 1, wherein it includes the one or more than one of the following operating modes:

   1) Low speed support operating mode: When the target surrounding temperature is higher than the ON point of the preset level (i.e if the temperature is higher than this value, the compressor pump will be driven), the compressor pump is driven by the compressor pump driving device at the high power rate high speed OFF point of the preset level (i.e. the conventional single speed compressor pump is stopped if this temperature value or lower value is reached), the compressor pump is switched to low power rate low speed operation, and if the target temperature is further lowered, the pump is stopped; thereof if the target temperature is slowly risen to the ON point of the preset level when the pump is driven at the low power rate low speed operating status, the compressor pump is switched to high power rate high speed

operation to lower the target surrounding temperature to the OFF point of the preset level and is further switched to low power rate low speed to drive the compressor pump, and the cyclic operations are continued as said, wherein this mode is applicable for medium target temperature loss operation requirements;

2) Low speed constant temperature operating mode: When the target surrounding temperature is higher than the ON point of the preset level (i.e if the temperature is higher than this value, the compressor pump will be driven), the compressor pump is driven by the compressor pump driving device at the high power rate high speed OFF point of the preset level (i.e. the conventional single speed compressor pump is stopped if this temperature value or lower value is reached), the compressor pump is switched to low power rate low speed operation, and if the target temperature is further lowered, the pump is stopped; thereof if the target temperature is slowly risen to the ON point of the preset level when the pump is at the stopping status, then the compressor pump is switched to low power rate low speed operation to lower the target surrounding temperature to the OFF point of the preset level and is further switched to low power rate low speed to drive the compressor pump, and the cyclic operations are continued as said, wherein this mode is applicable for slower target temperature loss operation requirements;

3) For the larger target surrounding temperature loss, it is operated according to the conventional single stage high rotating speed driving system mode.

3. The multi-stage driven type compressor pump driving system for air conditioning and refrigeration applications as in claim 1, wherein for application in air conditioners, the following interface devices are further installed:

- An interface driving circuit ID100: It is constituted by electromechanical devices or solid state electronic components to receive the operating signals of the central controller unit CCU100 to control the operating time of the air conditioners and to control the fan F100 for startup or stop or varied speed operations and wind direction controls as well as to drive the display device DP100 or other interface devices.

4. A multi-stage driven type compressor pump driving system for air conditioning and refrigeration applications, the system comprising a power source, a compressor pump, a compressor pump driving device for driving the compressor pump, a driving control device controlled by a central controller to control the output rotational speed of the compressor pump driving device, an input operating device, an internal preset automatic control device, and an environment detector device for detecting a target temperature and transmitting a signal to the central controller unit.

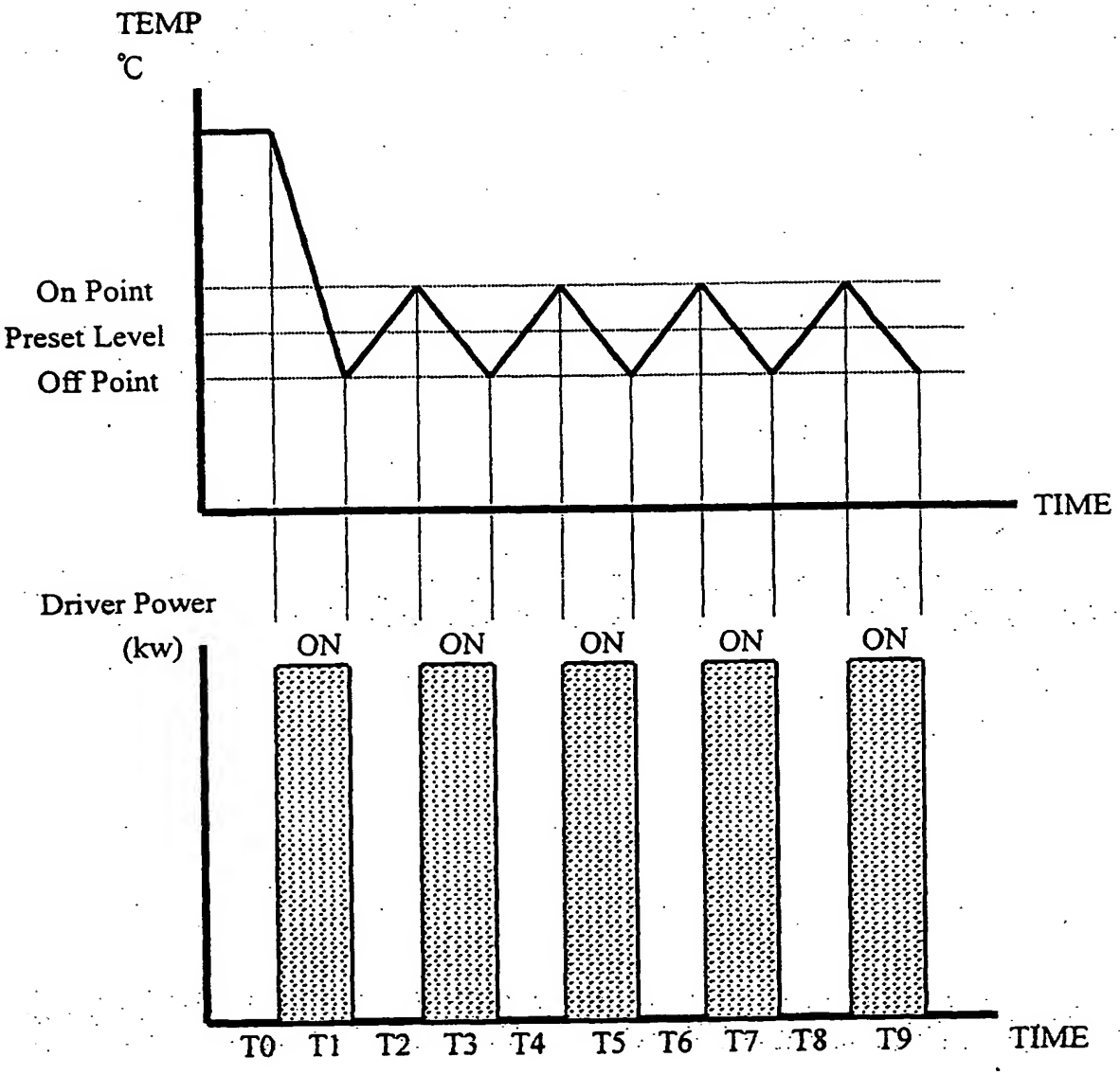


FIG. 1

PRIOR ART

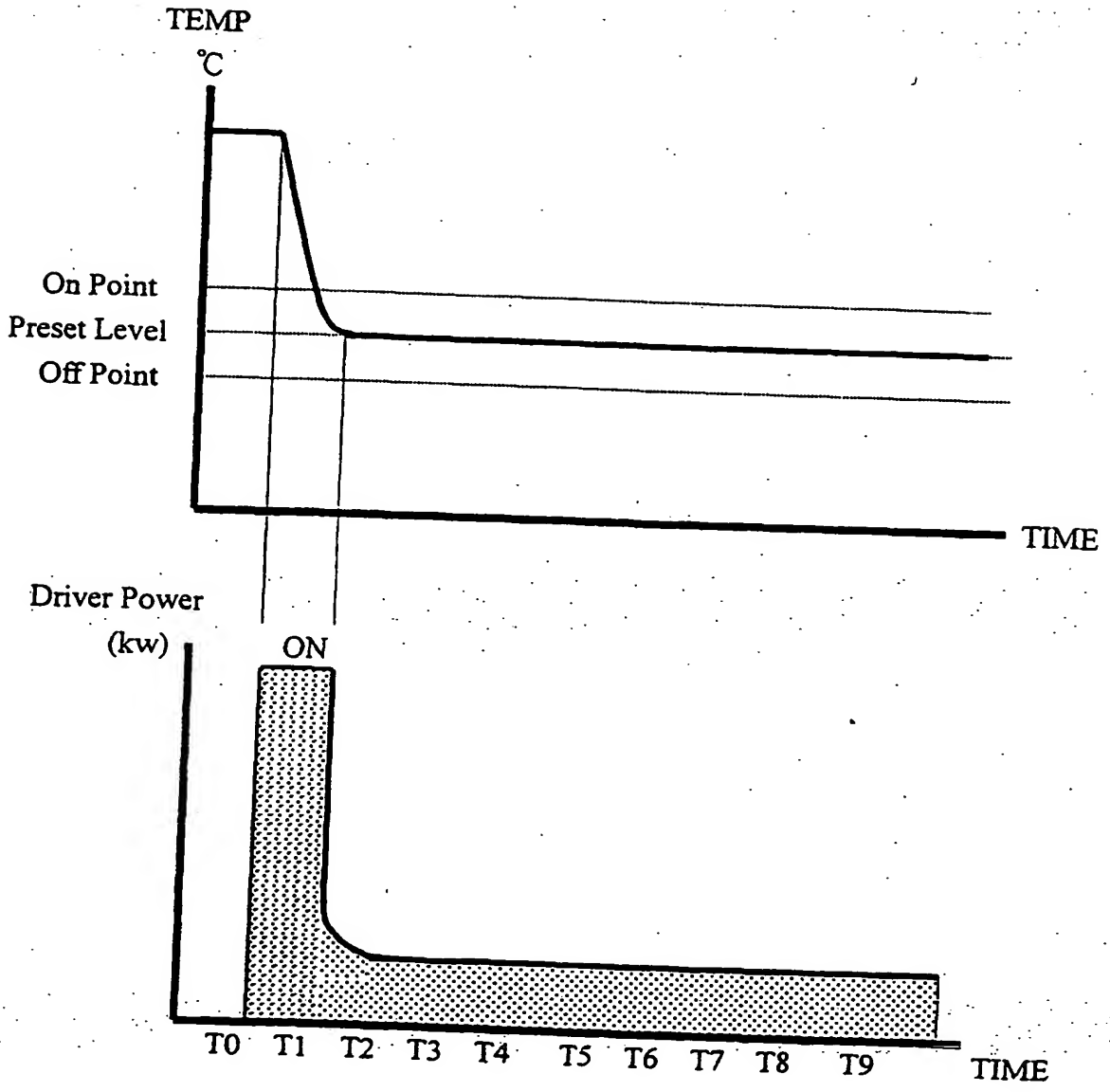
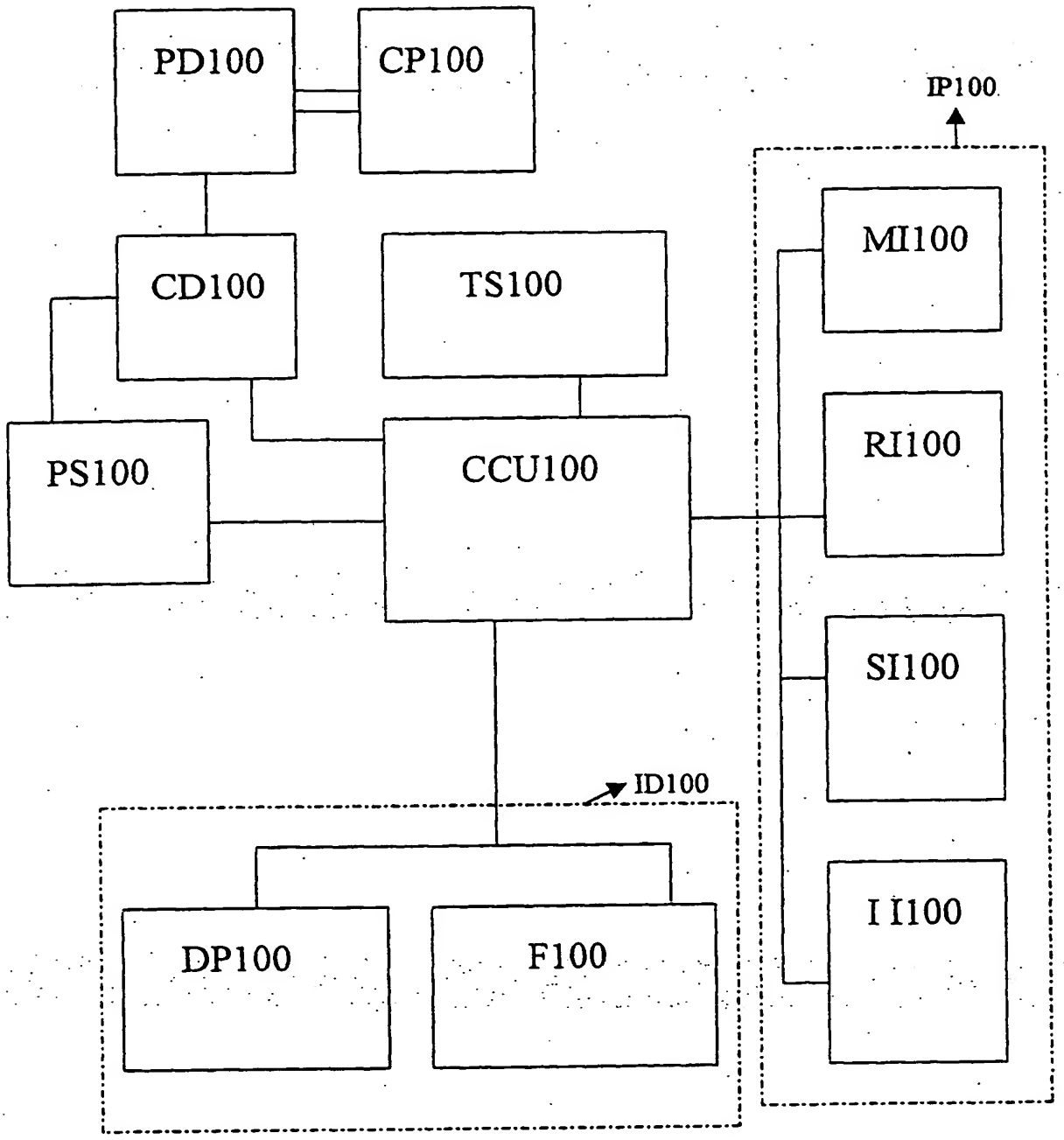


FIG. 2

PRIOR ART


PD100
CP100
IP100
MI100
CD100
TS100
RI100
PS100
CCU100
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ID100
II100
DP100
F100

FIG. 3

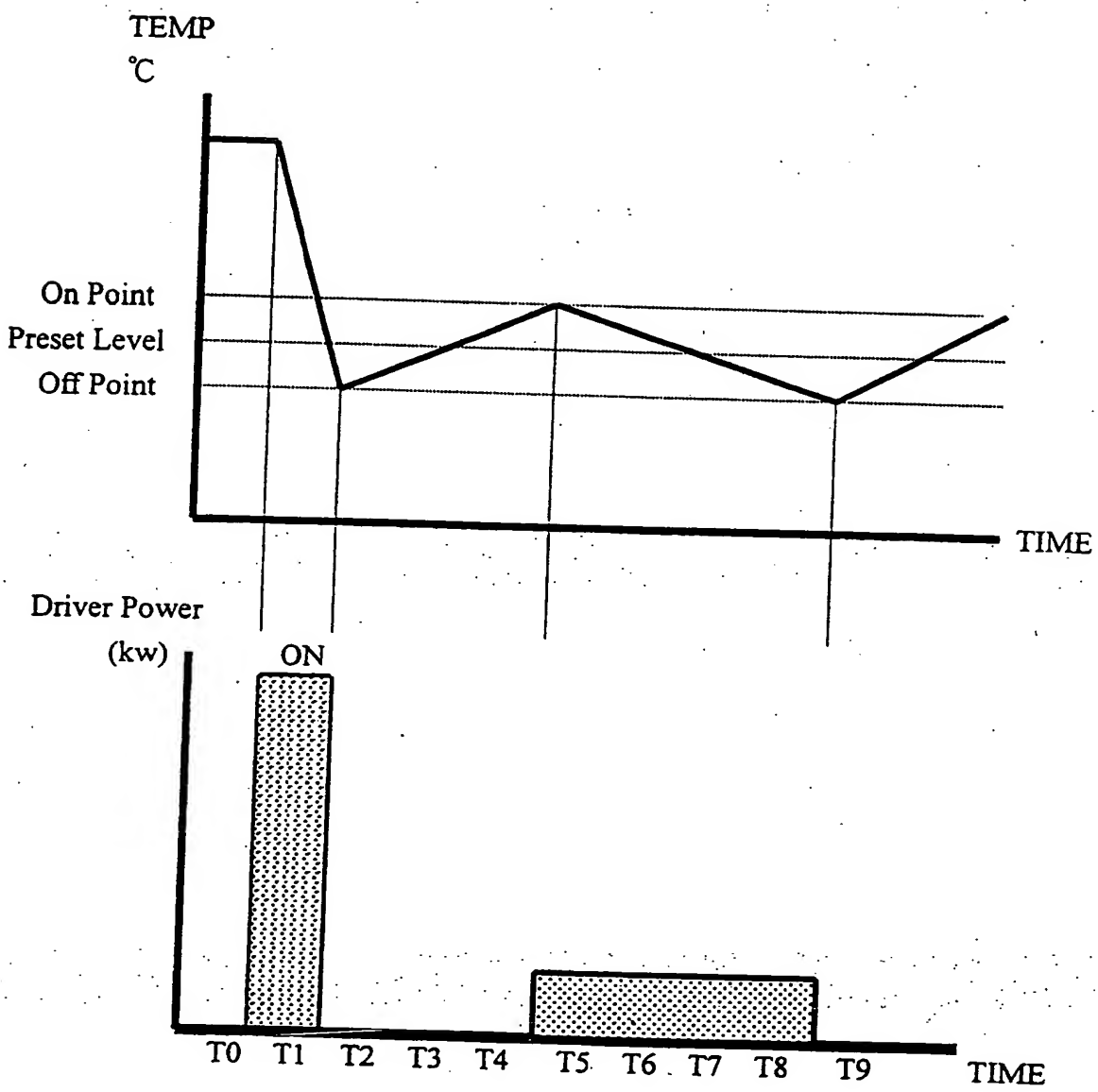
TEMP
℃
On Point
Preset Level
Off Point
TIME
Driver Power
(kw)
ON
T0
T1
T2
T3
T4
T5
T6
T7
T8
T9
TIME

FIG. 5